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## **Introduction**

The Sleep and Performance Research Center (SPRC) conducts human and animal studies in laboratory and field settings in support of basic and applied sleep research at Washington State University (WSU). The SPRC focuses on understanding the brain organization of sleep in humans and animals and on using this understanding to link sleep, by way of the underlying neurobiology, to key indicators of performance, be they physiological, behavioral or cognitive. The research contributes to sustaining human productivity, safety, health, and well-being and may contribute to the understanding of the neurobiology of consciousness.

The SPRC core faculty members are:

Gregory Belenky, M.D., Research Professor, VCAPP, WSU Spokane (SPRC Director)

Christopher Davis, Ph.D., Assistant Research Professor, WWAMI, WSU Spokane

Lois James, Ph.D., Assistant Research Professor, Criminal Justice and Criminology, WSU Spokane

Levente Kapás, M.D., Ph.D., Associate Professor, VCAPP, WWAMI, WSU Spokane

Ilia Karatsoreos, Ph.D., Assistant Professor, VCAPP, WSU Pullman

James Krueger, Ph.D., Regents Professor, VCAPP, WWAMI, WSU Spokane

Jaak Panksepp, Ph.D., Professor, VCAPP, WSU Pullman

David Rector, Ph.D., Professor, VCAPP, WSU Pullman (left WSU in 2011)

Éva Szentirmai, M.D., Ph.D., Assistant Professor, VCAPP, WWAMI, WSU Spokane

Hans Van Dongen, Ph.D., Research Professor, VCAPP, WSU Spokane (SPRC Assistant Director)

Bryan Vila, Ph.D., Professor, Criminal Justice and Criminology, WSU Spokane

Jonathan Wisor, Ph.D., Associate Professor, VCAPP, WWAMI, WSU Spokane

The current eleven SPRC core faculty members are all involved in sleep research and their productivity is evidenced by their collective publications and extramural funding. SPRC core faculty members are internationally renowned for their scientific contributions, which have led to paradigm shifts in science and policy changes at the state and national levels.

## **Program of Research**

### **Field Studies in Humans**

Slaven et al. (2008a) analyzed actigraphic records to score sleep.

Slaven et al. (2008b) conducted a multi-dimensional analysis of the actigraph signal.

Vila and Moore (2008) described the impact of long work hours on police officer performance.

### **Laboratory Studies in Humans**

Gunzelmann et al. (2008) constructed cognitive models of individual differences in sustained vigilance.

Luik et al. (2008a) studied the individual differences in human polysomnographic variables.

Luik et al. (2008b) studied individual differences on a letter fluency task in sleep deprivation.

Molicone et al. (2008) conducted response surface mapping of individual neurobehavioral mapping.

Oonk et al. (2008) studied the determinants of excessive daytime sleepiness.

Vila et al. (2008) developed metrics of police deadly force performance in sleep loss.

### **Laboratory Studies in Animals**

Churchill et al. (2008) studied the role of tumor necrosis factor in the promotion of local cortical column sleep; Foust et al. (2008) developed optical neural recording during sleep; Iwahana et al. (2008) studied gonadal steroids and their effect on circadian rhythm; Kapas et al. (2008a) studied influenza induced sleep and its modulation by TNF alpha; Schei et al. (2008) used infra-red imaging to image action potential propagation; Yan et al. (2008) analyzed the spatial and temporal aspects of SCN circuitry; Yeager et al. (2008) developed optical electrodes to record cortical activity.

### **Reviews**

Belenky et al. (2008) reviewed the literature on split sleep and modeled its effects on performance. Kapas and Szentirmai (2008) reviewed regulatory factors in sleep. Karatsoreos, Pfaff, and McEwen (2008) reviewed the effects of androgens on circadian rhythms. Krueger et al. (2008) reviewed the theory of local sleep as a

function of neuronal assemblies. Krueger, Rector and Churchill (2008) reviewed the role of cytokines in local sleep. Krueger (2008) reviewed the humoral regulation of sleep and implications for sleep as a use dependent process. Krueger et al. (2008) reviewed the evidence for sleep as a fundamental, emergent property of neuronal assemblies. Krueger (2008) reviewed the role of cytokines in sleep regulation. Roy et al. reviewed neural network models of use-dependent local sleep. Van Dongen and Belenky reviewed the literature on alertness and its modulators.

### **Key Research Accomplishments**

- Advances in interpreting actigraph records to enable field studies of sleep
- Description of the impact of long work hours on operational performance
- Development of cognitive models predicting direct measures of performance and other neurophysiological parameters affected by sleep loss
- Advances in the understanding of the role of local sleep regulatory substances in sleep and sleep loss
- Extensive reviews of the literature on human and animal sleep and performance

### **Reportable Outcomes**

- Long work hours affect human health and performance by encroaching on sleep opportunity and creating acute and chronic sleep loss
- Mathematical models combined with quantitative cognitive architecture are useful for understanding and predicting the effects of sleep loss on human performance

### **Conclusions**

Sleep, sleep loss, and performance are active areas of research with progress being made through field studies of humans, laboratory studies of humans and animals, field and laboratory studies of humans, and scholarly review of the existing scientific literature.

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